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ABSTRACT

How a multimedia program that employs concept maps and hypertext for teaching "Hamlet" facilitated comprehension in an undergraduate course is described. Results suggest factors that instructional designers should take into account to improve learning. Thirty-six upper-division college students were enrolled in a course on Shakespeare at a regional university. Using HyperCard, a document for teaching and interpreting "Hamlet" was prepared. Characterization, plot, literary analysis, and perspective on revenge that were built into concept maps were the principal interface of the program. Video commentary by the course instructor juxtaposed to an available screen portrayal of "Hamlet" advanced the major interpretations of the play. A 25-question objective test measured student learning. The experimental group outperformed the control group on this measure of learning. Results suggest that the multimedia document was useful in consolidating knowledge from the play. The interface design appeared to aid students in acquiring major concepts. One table and two figures illustrate the findings, and attachments illustrate some of the hypertext screens. (Contains 26 references.) (SLD)

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Constructing Knowledge from an Ill-Structured Domain: Testing a Multimedia Hamlet

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Constructing Knowledge from an Ill-Structured Domain: Testing a Multimedia Hamlet

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Introduction

In the last ten years multimedia documents have emerged as a new technology for learning information in higher education. But with change, problems have emerged in regard to learning from microcomputer texts embellished with full motion video. The growing usage of hypermedia allows readers to browse large documents. The user controls the order for inspecting different topics. One advantage of this approach is that a hypertext organizes assorted primary and secondary sources into one space for reading. The author guides students through these materials according to patterns determined by the user. Although researchers have described how these non-sequential texts within hypermedia branch to associated information, there is not common agreement about how best to design an interface that takes into consideration fruitful areas of research in learning (Boorsook and Higginbotham-Wheat, 1992; Landow, 1990; Gay and Raffensperger, 1989). Hypertext offers no guarantee that users can link new ideas to prior knowledge especially when information appears in a loosely structured or random fashion. If successful learning is to take place, a cohesive framework must integrate the new with the old. For example, links inside of hierarchies or between superordinate and subordinate categories provide structure (Cates, 1992). Therefore, one perspective taken here is that the organization of concepts should steer instructional design. Multimedia projects that follow this guideline, I propose, will increase the comprehension of users.

In this paper, I will describe how a multimedia program employing concept maps and hypertext for teaching *Hamlet* facilitated comprehension in an undergraduate course. The results of this study suggest what instructional designers of software should take into consideration to improve learning.

Hypertext

Hypertexts are often described as a superior means to drive learning and comprehension (Nelson, 1987). Nevertheless, the medium when coupled to multimedia is not without problems. One problem is the tendency of users to get lost in a document (Heller, 1990). The number of paths and directions to follow within hypertext can provide an overwhelming number of choices. The documents are often large and disorienting (Fraase, 1990) or too unfocused (Gay, 1986). Users may not know how to use menus, buttons, and dialog boxes to navigate through hypertext (Fraase, 1990). Conventional printed materials offer a starting point at the beginning of an article from which readers move in a linear fashion to the end. On the other hand, hypertexts allow rapid browsing because of their free form design. When readers interact with multimedia, they explore and construct knowledge in an environment where they control the pace of their learning (Gay and Raffensperger, 1989). Nevertheless, novices may be unaccustomed to these conditions when using electronic documents initially. As partial solutions to difficulties in navigating hypertext, designers have experimented with maps, icons, timelines, and thumbnail images for keeping users oriented and providing common reference points (Fraase, 1990; Apple Computer, Inc.,1989).

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One designer of travel books has assembled a set of rules to eradicate confusion with maps of unfamiliar cities. A well designed guidebook (and by extension, a multimedia document), by taking into consideration these principles, would assist readers by:

- "finding personal pathways to understanding"
- "selecting the pertinent from the superfluous"
- "transforming data into information"
- "extracting the full measure of meaning"
- "improving powers of information reception"
- "finding the appropriate organizing principle of different subjects" (Wurman, 1989, p. 41).

Although most of his work lies outside of software design as a commercial publisher of telephone books and subway maps, Wurman believes that complicated subjects have a structure of their own. Proper design takes advantage of this structure to reveal meaning. Unless this consideration of design takes place, a reader cannot acquire information (Wurman, 1989). This principle is a reworking of the maxim "Form Follows Function." However, comprehension of text and integration of new knowledge is more involved than design decisions because prior knowledge varies between students.

With hypertext, the reader assembles knowledge by examining ideas from different perspectives and in different contexts. If I organize a multimedia document by chronology, location, alphabet, continuum, and category, I risk confusing readers by intermixing frames of reference (Wurman, 1989). Worse, failure to account for variation in prior knowledge among users may hamper the assimilation of ideas. "Considerate" and "polite" software, in a "user-friendly" sense, should have starting points that ground students in prior knowledge as support systems for novices. Without such safety nets, failure to learn with hypertext will occur when schema have not been activitated or do not exist on which to hang new information. Hypertext may aggravate this situation by rapid movement to new topics without reference to what the reader knows and has already explored in the document. An unguided reader may experience the burden of providing all of the continuity between old and new knowledge. How then should a student best acquire new information from multimedia documents with hypertexts?

Ideally, students can explore ideas and objects in their environment and, by doing so, construct their own knowledge system of how the world works. Over time, children and adults modify and refine these cognitive models of reality (Schneiderman, 1992). Hypertexts need a structure in which text descriptions of objects and events are coupled with video, audio, and graphic representations. This is a design issue which must be resolved.

Concept Maps

Concept maps are graphic organizers that structure knowledge into nodes linked to other ideas. These connections show the relationships between ideas (Novak & Gowin, 1984). A grouping of related concepts with many linkages form schema; congregations of specialized & complex knowledge such as that understood by experts are termed domains. Because concept maps are a mediating form of representation between strict lists or outlines and descriptive prose, they impose a graphic organization on a domain. Successful users descend to their level of prior knowledge and use the links to other concepts to assimilate new knowledge. Interface designers should also realize how users construct meaning and formulate rules (Novak, 1990). If done well, a document builds in reader strategies for learning new ideas (Cates, 1992). In the end, it is important what users understand about new information--not just what they remember about unrelated facts. Concept maps working as an interface to software allow readers to see knowledge organized cohesively.

Cognitive Flexibility Theory

The effect of hypertext on learning may be most apparent in students who study multiple analogies and discover patterns and links to previously learned concepts (Feltovich et al., 1989). Spiro and his associates (1989) argue that students typically over generalize from low level knowledge to more complex concepts and thus engage in reductivist thinking. In studies of medical students who inappropriately applied concepts of blood pressure and properties of cardiac muscles, the use of simple analogies hindered the understanding of factors related to high blood pressure and heart failure (Feltovich et al., 1989). The medical field is an ill-structured domain of knowledge because information in the field does not fit neatly in

patterns. For example, pharmaceuticals cause entirely different reactions in individuals; these effects are not predictable for individual differences. Therefore, a single case study may be a very dangerous circumstance in medicine from which to generalize. However, individual studies of patients may be useful when used in a composite fashion with other analogous cases.

Spiro and his colleagues (1987) argue that a variety of cases shatters the convenient package that most textbooks rely upon:

1. There are no rules or principles of sufficient generality to cover most of the cases, nor defining characteristics for determining the actions appropriate for a given case.
2. Hierarchical relations of factors are inverted from case to case.
3. Prototypes tend to be misleading.
4. The same features of a single case assume different patterns of significance when placed in different contexts.
5. An explosion of higher order interactions among many relevant features introduces aspects of novelty in cases.

The implication for education is that conditions and materials for learning in a well-structured domain may be entirely ineffective when dealing with student learning in an ill-structured domain. This term refers to "conceptual complexity" and the lack of consistency across cases--both of these features are characteristic of advanced subject matter (Spiro et al., 1988). In addition, low level prior knowledge may not be applicable in new situations (Spiro et al., 1987). In these cases, Cognitive Flexibility theory requires alternative strategies to acquire knowledge in ill-structured domains including changes in texts. Specifically, there must be multiple connections within the domain to explore its features. Rival interpretations of the same phenomena or information must be reported. The document must include adequate representation of different and contradictory cases and allow for complexity and irregularity in the domain. One implication is that users must construct schema from fragments of knowledge outside of the conventional presentation of topics in a text (Spiro et al., 1987). Students must use a pattern of "criss-crossing" the content of a domain to derive the correct context of cases (Spiro & Jengh, 1991).

Multimedia designs accede easily to the criss-cross learning pattern. Of course this is the metaphor of forest rescuers hunting for a lost child in a thorough search pattern. Within multimedia, hypertext and video sources combine in ways that students can impose their own framework on a complex and ill-structured domain (Spiro & Jengh, 1991).

Experts and Domains

New software whose design is based on constructivist theories have emerged. These tools are derived from the concepts held by a specialist, termed the domain expert, and the knowledge engineer, technically a programmer who fashions schema together using knowledge acquisition principles. These individuals collaborate to synthesize a representation of the domain (Ford et al., 1993).

Using this process, a team designed IKONKAT to allow users to probe a domain through a questioning format (Ford et al., 1991). These selections lead to concept maps which simultaneously present broader and more focal treatment of knowledge. Investigations of these ideas culminate in repertory grids which are mediating representations of the domain (Ford & Adams-Webber, 1991). These outcomes emerge from the interaction between the domain expert and the knowledge engineer. The process begins with the eliciting of expertise from an individual into a computer model. Testing of the adequacy of this knowledge base leads to a more complete set of schema for instruction. The issue at hand is whether the model can account for the variability that exists in complex domains of knowledge. The use of concept maps and repertory grids in this model allowed the experimenters to tap the personal knowledge which the expert had internalized.

As an example of this process, is it possible to explain how anyone chooses a restaurant in which to eat? Multiple factors contribute to such a decision including cuisine, location, dining partner, atmosphere, time of day, quality of service, reputation, and size of the dining areas. A knowledge engineer can fashion all of these collective variables into a model which improves as variables interact to increase explanatory adequacy (Ford et al., 1991).

Similarly, NUCES is an expert system for medical practitioners to assess data within a Nuclear Cardiology domain (Bradshaw et al.,

1993). A user can draw upon multimedia documents, repertory grids, and many graphic images to produce an explanation from single case data. NUCES relies on a series of nested concept maps arranged in a hierarchy for navigation and for exploring diverse areas of the domain (Bradshaw et al., 1993).

The concept maps within NUCES and ICONKAT drive the systems because the models are no better than how complete a set of nodes existed in the concept maps. With such an elaborated set of schema, an expert system can steer novices through the representation of knowledge held by a specialist, akin to viewing reality through another's eyes. In sum, NUCES and ICONKAT demonstrated that concept maps could function simultaneously as a knowledge base to guide others through a domain and as the technical interface for passing users through a software document in a structured fashion (Ford et al., 1991; Bradshaw et al., 1993). This dual role suggests that the disorientation and ambiguity described in the multimedia literature can be eliminated by pairing expertise with hypertext to allow free form browsing that is always anchored to a framework of knowledge. In this way, I propose that concept maps can represent internal structures and provide navigational aids to the document. Therefore, design considerations must align information with advance organizers, hierarchies, graphic data, and previews of what the learner will acquire (Ellis, 1992).

Cognitive flexibility assumes mastery of a knowledge strand will occur when ideas and information can be explored from many perspectives. Multiple views taken of objects and events, rival interpretations made from the same data, and partial or full exceptions drawn from cases are rich landscapes which generate new meaning when juxtaposed to each other (Spiro et al., 1988). The successful represenation of a large domain with concept maps in NUCES signals that order can be imposed on hypertext. However, this structure molds comprehension.

The Domain of Shakespeare

Literature is a highly complex and ill-structured domain. Although literary features appear universally in books, e.g. setting, characterization, initiating event, character response, etc., these components of a story grammar do not confine literature narrowly. Literary criticism as a domain varies substantially from cardiology and biomedical engineering. How then can hypertext designs apply cognitive strategies equally well across domains to traverse knowledge landscapes (Spiro and Jehng, 1991)? Applying a portion of the knowledge acquisition shell of NUCES and ICONKAT to Shakespeare's work would mean using concept maps to structure an expert's domain of a play and guide users through the system. These features are the elements I tested in the present research with an undergraduate course in English literature.

In regard to assimilating Shakespeare's drama, there are broad interpretations which lend weight to one faction or another in criticism. In Shakespearean comedy, characters manipulate events to facilitate seduction and marriage. In Shakespearean tragedy, characters mutate as events unfold around a murder. The plays explore traditional themes such as Good vs. Evil, ambition, unfettered love, but, in *Hamlet*, Shakespeare reworks Revenge Tragedy. This issue thrusts characters into the role of avenging dishonor to a family relation in disregard of custom, the law of the land, or personal inclination. In other words, Hamlet appears doomed after embarking on the path of personal revenge. Grief for a dead father is dissected while Hamlet is half unhinged by doubts about the veracity of a ghost's message. Shakespeare crafted a particularly odd character, 30 years old, still in college, and stalled over the issue of how and when to exact revenge. Kept from his girlfriend, angered by her apparent collaboration with his enemies, and exasperated by the incestuous nature of his mother's hasty re-marriage and her sexual tie to his father's murderer, Hamlet is absorbing because of the swirl of conflict around him within the play. From Act I to Act V, he makes a transition from grief and passivity to anger and violence. He tries to sort out Good from Evil within each character he encounters. The play runs to every extreme from purity to debasement, loyalty to treachery, truth to deceit, and life to death. *Hamlet* is complex.

This is the kind of knowledge domain that appeared suitable for development with cognitive flexibility hypertexts because I could maintain the complexity of the play without the analysis being simplified (Spiro et al., 1991). A hypertext designed from an expert's domain would allow

students to interact with each concept map node for learning the themes and literary structure of *Hamlet*. This transaction with the play would go further than the lectures and the individual reading of the assigned text especially if students do not show initiative and read criticism in the library. By carrying out an experiment using a multimedia document built with hypertext features, I hypothesized that the experimental group would acquire more of the knowledge domain than the control group.

Method

Research Setting and Sample. 36 upper division college students were enrolled in a course on Shakespeare offered by the English department of a regional university. A computer used a random number generator to assign student names to the experimental and control groups. Two members of the treatment group could not participate due to their work schedules and the distance that they commuted to the university. Two members of the control group were dropped from the experiment when they failed to attend class to hear the lectures and to take the pre-test. Therefore, 32 students, split evenly between the control and experimental groups, participated in the study. There were six non-English majors in the treatment group and four in the control. The range of ages among the students in this sample varied between adults over 50 to age 20. Most students were in their early 20s.

The Multimedia Document. Using HyperCard® to author a document with multimedia links, I created a large document for teaching college students the major concepts for interpreting *Hamlet*. Specifically, the lecturer and the experimenter developed a domain over several weeks of what is important for undergraduates to learn in *Hamlet*. Characterization, plot, literary analysis, and perspectives on revenge are the principal concepts built into the document. I fashioned these into concept maps as the principal interface of the program. The maps allow a user to pursue concepts to a subordinate or superordinate level. After selecting a concept and link from a map, the user saw a set of selections on the screen. These options included segments from the Zeffirelli version of the play on a video laser disc, written commentary on these segments, the actual text of the play, literary criticism, and links returning the user to the concept maps. Video commentary by the course instructor, juxtaposed to a portrayal of Hamlet by Mel Gibson, advanced the major interpretations of the play from the concept maps. This video commentary was produced from 8mm video segments of the instructor. The experimenter converted the videotapes into digitized computer files. These files were edited by a technical team into shorter selections using full-motion video segments from the movie overlaid with the audio and video narration of the instructor. The video commentary was saved in QuickTime® format. The experimenter linked these multimedia narratives to the document. When a user selected a specific item from the concept map, a small window popped up on the screen and this short video commentary began. There were four concept maps to browse through and these linked to 85 screens of additional information and another 40 screens of more focal criticism. Links to the full text version of the play were visible at every level. Additionally, I created laser disc controls at the bottom of each screen for allowing users to view the *Hamlet* laser disc beyond what had been selected to illustrate a point in the document. These video controls were built from objects designed in the Voyager VideoStack.® Users could print out any screen which interested them. The document was loaded on a Macintosh 840AV® computer which displayed the concept maps and QuickTime™ movies on a 21 inch monitor. Some of the links within the maps engaged the video laser disc using buttons, scripts, and drivers created with the Voyager VideoStack.® These segments appeared on a separate video display adjacent to the computer. This arrangement allows as many as four users to interact with the document and view both screens simultaneously.

Research Procedures. The experiment took place over 8 days. This period was marked by the administration of the pre-test on the first day of the experiment and the post-test on the last day. This work was conducted during the regular time set for lectures in the course. The course instructor followed his customary pattern of giving three lectures on a Shakespearean play, in this case *Hamlet*. The pre-test was given immediately before the first lecture of the cycle. Subjects were unaware of which group they had been placed until after the end of the class. Following the completion of the lecture, control subjects were excused from the room and the

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remaining experimental group was signed up for an appointment to interact with the multimedia document in the next seven days. The experimenter oriented students to the location of the multimedia laboratory and passed out appointment cards. The instructions given to the students included the requirement of not discussing the treatment with anyone until after the experiment was finished in a week.

In the multimedia laboratory, I oriented the subjects to the workstation where they would view the Hamlet document. Each user learned to interact with the document and how to control the video laser disc from the concept maps. The controls for printing screens and moving to each feature were demonstrated. Most of the subjects viewed the document in groups of two or three. Three subjects interacted with the Hamlet multimedia document individually. Generally, the students read through all software screens and watched most of the video segments in 90 minutes. One group discussed several sequences extensively among themselves and they finished after two hours.

Instrumentation. A 25 question objective test was devised to test for the concepts which would be taught in the lectures and reiterated in the Hamlet Multimedia Document with which the experimental group interacted. Students had as much time as needed to finish this measure which remained the same from pre to post. Most students spent 5 or 6 minutes working on it. The experimenter wrote the test. The lecturer read the instrument, edited it, and made changes to it.

1. Hamlet is happy to see the men who have spotted the ghost. T F
2. Hamlet and Ophelia are engaged. T F
3. Ophelia remains in Elsinore with her brother, Horatio. T F
4. The citizens refuse to bury King Hamlet. T F
5. In *Hamlet*, a spy is sent to France. T F
6. Ophelia is encouraged to seek Hamlet as a suitor by her mother. T F
7. Polonius, Ophelia's father, wishes her to play 'hard to get.' T F
8. Guildenstern turns treacherous to Claudius. T F
9. Rosencrantz turns treacherous to Hamlet. T F
10. Hamlet innocently kills Rosencrantz and Claudius purposely murders Guildenstern. T F
11. Hamlet is willing to swear revenge when prompted by the Ghost. T F
12. Gertrude wishes for Ophelia to become her son's wife. T F
13. After Hamlet returns Ophelia's love letters, she goes mad. T F
14. When the ghost appears, Hamlet receives momentary pleasureat seeing the form of his father. T F
15. Hamlet later points out to Horatio that the ghost may be a beneficial spirit. T F
16. Hamlet uses 'the play within the play' to:_____

17. *Hamlet* largely takes place in:
    a. England
    b. Scotland
    c. Germany
    d. Wales
    e. none of the above
18. Drunkenness is a characteristic of:
    a. Claudius
    b. Hamlet
    c. Polonius
    d. Horatio
    e. none of the above
19. In the play, Hamlet becomes more like:
    a. Claudius, his uncle
    b. his father, King Hamlet
    c. Horatio, Ophelia's brother
    d. his mother, Gertrude
    e. none of the above

20. Claudius as the King
    a. mishandles diplomacy routinely angering the nobles.
    b. orders Hamlet to his chambers to ward off suicide.
    c. spares the life of traitors as a sign of apparent goodwill.
    d. intends for Hamlet to return soon to Wittenburg for study.
    e. all of the above
    f. none of the above
21. A director can make Claudius more complex in character by:

    _____

22. Gertrude is best described as driven by:
    a) her passion and sexual needs.
    b) her need for political power.
    c) her need to control men in the court.
    d) her status and lifestyle as queen.
    e) none of the above
23. Hamlet kills Polonius because
    a) Polonius was trying to seduce Gertrude in her chambers.
    b) Hamlet impulsively thinks he is killing Claudius.
    c) Polonius thwarted Hamlet's efforts to become king.
    d) Hamlet knows Polonius has kept Ophelia from him.
    e) none of the above
24. The ghost must conclusively be good because:
    a) Hamlet is able to revenge the death of his father, King Hamlet.
    b) Claudius is shown to have no remorse or feelings for his acts.
    b) Hamlet is able to sort out good from evil within the court.
    c) Claudius is shown to be the usurper of the crown and a seducer.
    e) all of the above
    f) none of the above
25. Claudius might be said to move "by indirection" because:
    a) he dispatches Hamlet to England with two agents.
    b) he plots against Hamlet and has others do his bidding.
    c) he organizes a duel where Hamlet will lose no matter what.
    d) he murders people in a fashion that no one will suspect him.
    e) all of the above
    f) none of the above

The assumptions were that the subjects had to read the play by the end of the 3 lecture unit in order to have an adequate base of prior knowledge.

Results and Discussion

The results of the experiment employing

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a Two-Way Analysis of Variance with repeated measures are shown in Table 1 below. Within this upper division section of English literature, there was a significant difference between the experimental and control groups on the objective test covering *Hamlet*.

Table 1

Means and Standard Deviations

	N	M	SD
Treatment Pre	16	20.000	6.154
Treatment Post	16	28.312	3.701
	N	M	SD
Control Pre	16	21.688	5.782
Control Post	16	26.188	5.624

Results for Two-Way Analysis of Variance With Repeated Measures

Source	DF	Sum of Squares	Mean Square	FValue	PR>F
Model	2	213.01297	106.50649	6.14	0.006
Error	29	502.98703	17.34438		
Corrected Total	31	716.00			

The results suggest the multimedia document was useful in consolidating knowledge from the play. The majority of students requested copies of the four concept maps which they had interacted with. The framework of knowledge was spread across these screens of information. However, the subordinate levels of detailed knowledge, for which the students were also responsible within the play, became available on successively lower levels within the prototype. The concept maps gave a view of the domain.

While the results record a significant difference between the two groups, my own impression is that the lecturer of the course was so excellent that the effect of the multimedia document was somewhat negated. In other words, the lectures compensated to some degree for the advantages that the experimental group received. The lecturer was so steeped in Shakespeare that he could quote dialogue from *Hamlet* at length. He was highly interactive using a playful and seemingly effective Socratic style. He lectured on the major interpretations of the play, emphasizing the principal concepts on the chalkboard. He reviewed major stagings of the "play within the play" as comparative analysis using video segments. I believe that the students in the control group would have done less well on the post-test measure had they been required to rely more on their own reading of the play and less on the advantage of excellent lectures.

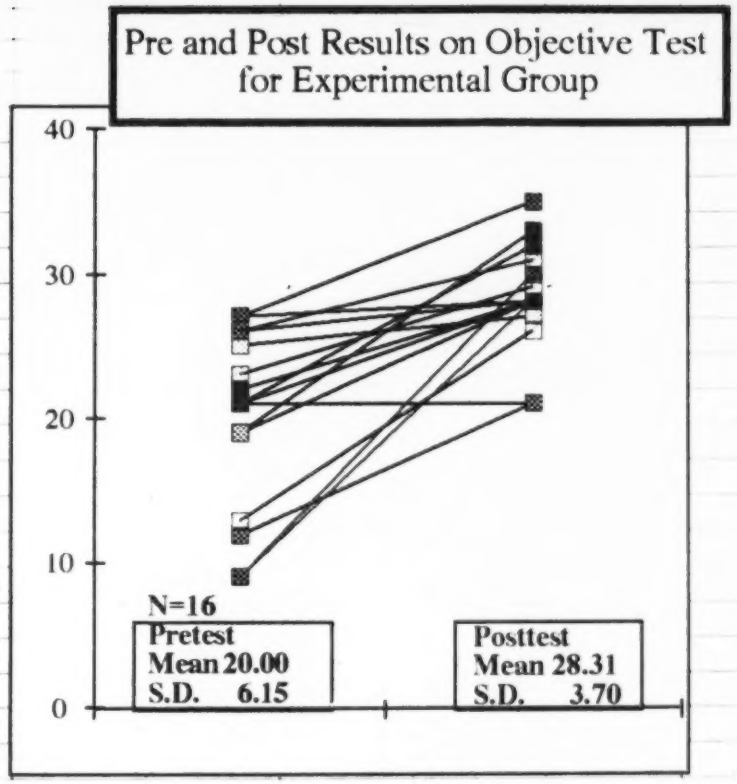
To gain some understanding of what the subjects were learning, I gave students in the experimental group an evaluation sheet to comment on their experience using the Hamlet Multimedia Document. The responses of the students suggested they had learned from the experience. What did they learn?

- "The Elizabethan belief about Revenge. Hamlet' view of Ophelia."
- "I have learned the ghost is viewed to be good. I have learned why Hamlet treated Gertrude and Ophelia the way he did."
- "The part about Hamlet's anger toward Ophelia and his mother was very enlightening. Many nuances of the play were more noticeable than if simply read."
- "For me, this lesson has been more of a review. Although, tying scenes together with themes helped me understand the intricacies of Hamlet's neurotic nature better."
- "More in depth avenues--with other views from my classmates I can see things in a different light."
- "Mostly clarification of Hamlet's motivations & feelings. --Also helped clear up relationship between Hamlet & Ophelia."
- "I have learned much more about the complex connections between all of the play's characters. I have gained a better understanding of Hamlet's intense emotions & motives."
- "The concept maps helped me understand how all of the different aspects of Hamlet are interrelated (it sort of high-lighted the "cause and effect" issues in the play)."
- "The relationship between Hamlet and Gertrude was of particular interest, and I was able to relate the relationship to Hamlet's motivations. Also the function of the ghost as a figment of Hamlet's imagination was a point that is open to question."
- "More than anything, the questioning of Hamlet's, Gertrude's, and some other characters

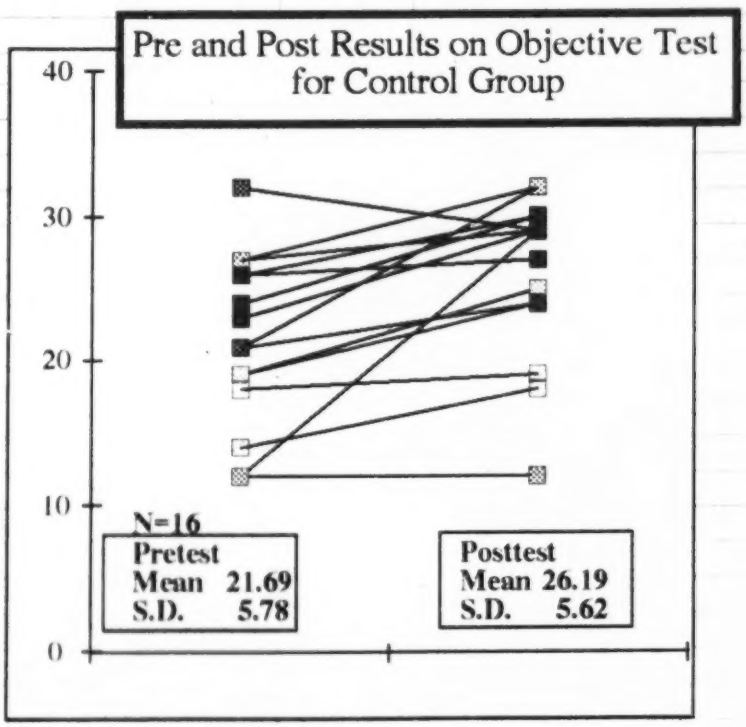
Multimedia Hamlet Document

W. Barnes, AERA, April 7, 1994
2 Way ANOVA with Repeated Measures

SUBJECT	Group	Major	Pre	Post
B2651	Treatment	N	9	28
B5828	Treatment	Y	21	21
C3738	Treatment	Y	27	28
G5053	Treatment	N	25	27
H1982	Treatment	Y	9	30
H9692	Treatment	Y	27	35
H8517	Treatment	Y	21	32
L9420	Treatment	Y	12	21
M2646	Treatment	N	21	28
M7090	Treatment	Y	19	33
N4759	Treatment	N	26	28
R3484	Treatment	Y	19	28
S3914	Treatment	Y	22	28
T7858	Treatment	Y	23	29
T1567	Treatment	N	26	31
W3731	Treatment	N	13	26
N=16	MEAN		20.00	28.31
	SD		6.15	3.70



L6263	CONTROL	Y	19	24
B3662	CONTROL	N	27	32
C6605	CONTROL	Y	19	25
C3315	CONTROL	Y	26	30
C3205	CONTROL	N	26	30
D3198	CONTROL	Y	24	30
;E2485	CONTROL	Y	12	29
G4180	CONTROL	Y	21	24
H8266	CONTROL	Y	26	27
L9649	CONTROL	Y	32	29
M7940	CONTROL	N	12	12
M6227	CONTROL	Y	23	29
M0078	CONTROL	Y	14	18
M0247	CONTROL	Y	27	29
S4311	CONTROL	Y	21	32
G7286	CONTROL	N	18	19
	MEAN		21.69	26.19
	SD		5.78	5.62



motives. That Hamlet's vision of the ghost may only be a figment of imagination when he speaks to it. And Gertrude may not have remarried so quickly because of lust, but because she liked the power of being queen."

• "More about the nature of Hamlet as a person. I've already seen Gibson in Hamlet, but with this analysis found more depth & import in the play than previously. This program makes the play fun & interesting to learn. I will be renting Hamlet again to watch in its entirety.

• "It's hard to tell, because I've had Hamlet 3 times already."

In effect, the students felt they had acquired explanations for Hamlet's behavior. Some felt in their comments that the concept maps connected ideas into a coherent framework.

There was also a considerable amount of interaction between the 13 experimental subjects who viewed the Hamlet Multimedia Document in small groups. Three students viewed the prototype alone. Those students who worked in a group asked questions of each other and compared differences of interpretation between the text and the video segments which illustrated concepts. The quality of the discussions, in my view, was high as the students raised questions which are not resolved in the document such as why Ophelia is so obedient, and why the watchers cannot hear the Ghost speak. The students touched the screen of the video display and pointed out different features of the concept maps to each other. One group discussed variations between the BBC, the Olivier, and the Zeffirelli versions of the play and reviewed different video segments of commentary intently. Some Mel Gibson sequences were re-played and discussed. This interaction is similar to that found within The Shakespeare Project, a multimedia document produced at Stanford University, which treated film versions in a comparative fashion for exposing students to different stagings of a scene (Friedlander, 1988).

The students in the present study tended to believe that participation in viewing the document and their own subsequent discussion were valuable activities:

• "The Analysis map worked best, because the discussion overlapped the video."

• "What can be said by the instructor is often resaid by a peer in a more understandable fashion. Speech between peers is more pleasant. [This is] best used in small groups."

• "By both viewing an outline of the play, we learn which segments of the play each of us is interested in. This leads to discussions regarding our different opinions about the play. I feel that more than 2 students should work on [a] computer. I think 3-5 students on one computer will stimulate more discussions. Very valuable!"

• "I worked alone but (after the experiment is done) I look forward to discussing the play and what I have learned through the project. I find interaction as important (sometimes more so) than just lectures."

• "Yes; obviously different people have different ideas, and this provides a ground to help exchange ideas one might not get from just reading the play."

• "I place a great value on discussions and interactions. I think it encourages thinking, and the development of ideas and possible answers to questions raised. I think it broadens the thinking of an individual when encountered with different ideas, thoughts, and theories."

• "We didn't discuss a whole bunch, but now we could discuss with a much deeper understanding than before. It would be great if there were a way to take this home one day! Or by similar learning formats. Just the flow charts do alot to explain the concepts."

• "We discussed the play a lot."

• "It does give the opportunity. But I've never been one for much discussion with my classmates."

Interface Design Recommendations

Within this study, the interface of this project appeared to aid students acquire the major concepts taught in the lectures on *Hamlet*. The design of the document centered on concept maps linked to video commentary by the lecturer, video laser disc segments of *Hamlet*, written commentary, literary criticism, and to a context-sensitive text of the play.

Recommendations for Further Research

It was apparent from reading student comments on the evaluation forms that students who are reticent during a lecture may participate differently while viewing a hypertext document with classmates. From a Constructivist view of learning, students who bind ideas together from the concept maps may also solidify knowledge by testing out views in small groups after interacting with multimedia. If trying out ideas

with peers is a form of hypothesis testing, then students moving from a hypertext document to discussion may be launched to a higher level of comprehension. This process needs to be studied and described.

Secondly, hypertext documents easily handle multiple interpretations of content. Comparative analyses of staging of *Hamlet*, suggested by Friedlander (1988) can be injected into the current program. However, I could design comparative views across all of Shakespeare's tragedies. What would students learn from such a large and complex document? English majors bring strategies for analyzing literature from other courses into new classes. Non-English majors may be at a disadvantage without this type of knowledge. The use of a multimedia hypertext document to compare plays, works, or genres may aid all students to interpret literature.

Third, some groups of students in the present study began discussing the play spontaneously among themselves. Multimedia documents explored in groups of three or larger may cast students into a heuristic mode. Why does this take place? Is the level of complexity or ambiguity so great that students must try to clarify information? Or do students find the document interesting and provocative because the information they have read disconfirms what they already knew? To what degree must data in a hypertext document correspond to what students already know?

Fourth, what are the characteristics of a "considerate" hypertext? How should designers plan for varying levels of prior knowledge among students? How should prior knowledge be activated?

Fifth, it was unclear how students made decisions for browsing and exploring while using the *Hamlet* document. Some groups explored all of the nodes on a single screen before navigating anywhere else. Others proceeded in a much more random fashion to traverse rapidly through the document. Which approach facilitates learning? What governs the selection of an orderly or random strategy? Are these navigational paths a reflection of the structure of knowledge that the learners already possess? How do students bridge the gaps in knowledge acquired from a hypertext document? Are students able to stitch together all of the salient elements and then search for the supporting links? If not, then hypertext documents must direct users to principal and subordinate concepts in an orderly fashion.

Sixth, what happens when students, as a small group assignment, extend a hypertext document by adding their own segments? What type of interaction and collaboration occurs in this process?

Lastly, I became aware from studying patterns on the pre-test and post-test measures that some students had not read the play at different points of time during the experiment. I have begun to wonder whether the act of exploring the hypertext document sets up students to "receive" the concepts that the lectures were designed around. In some cases, reading the text of the play is the appropriate first activity. In another case, viewing the BBC or any other version of the play may prepare secondary school and undergraduates for mastering *Hamlet*. What occurs when a multimedia exploration of the play happens before the text is read? How would student generated concept maps evolve at each successive step of reading the play, viewing a video of the play, attending lectures, using a hypertext document, and participating in a peer discussion of *Hamlet*?

These inquiries, once explored, will suggest how students can learn optimally under different conditions with cognitive flexibility hypertexts (CFH).

Summary

This study found that an experimental group in an undergraduate Shakespeare course outperformed a control group on objective measures after exploring a multimedia hypertext document.

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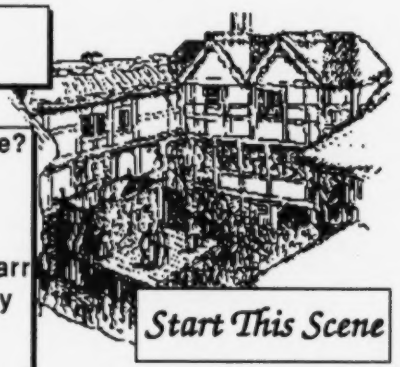
Notes: HyperCard,® QuickTime,® and Macintosh,® are registered trademarks of Apple Computer, Inc. The movie version used in this multimedia document was Hamlet, directed by Franco Zeffirelli. It is a production of Time/Warner, Inc. Voyager Video Stack® is a registered trademark of Voyager, Inc.

[1] Paper presented at the annual meeting of the American Education Research Association, April 7, 1994, New Orleans, LA.

Hamlet 6/26/93

Hamlet Transfers His Anger from His Mother to Ophelia



17 What wilt thou do? thou wilt not murder me?
ACT III:SC IV:21

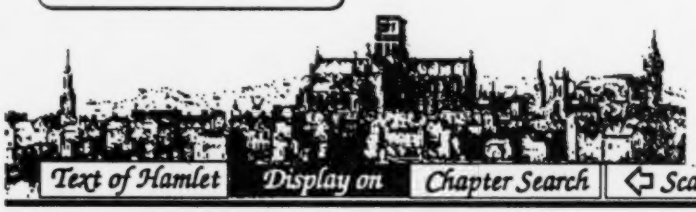
Hamlet's murderous mood turns instantly from Gertrude to the intruder behind the arras. Polonius' murder, no doubt impulsive, is as bizarr an act as the victim's regular compulsion to spy and meddle.

In truth, this is the turning point of the play. Ophelia rapidly becomes deranged, and the actions of Laertes sets in motion the vehicle for Hamlet to avenge the death of his father.

Start This Scene

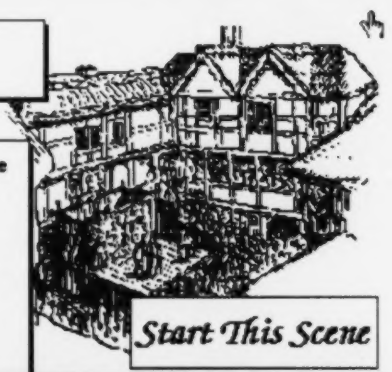
See Lines of this scene...

Next Segment



Text of Hamlet | Display on | Chapter Search | ⇦ Scan ⇨ | Play VCR | Stop VCR

Hamlet Transfers His Anger from His Mother to Ophelia

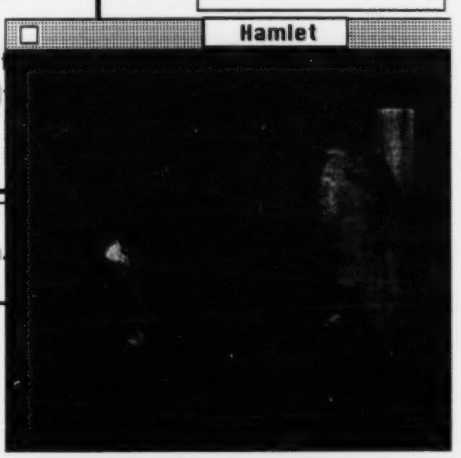


18 Gertrude. "What have I done, that thou darest wag thy tongue In noise so rude against me?" III.iv.38-39

Having murdered Polonius, Hamlet turns on his mother in an angry outpouring of words he has been harboring for the dishonor that she has imposed on him and his dead father.

In the comparison of the likenesses of the kings on the lockets held by Hamlet, Claud described as a "sow's ear," and a "moor" meaning a barren waste land.

Start This Scene

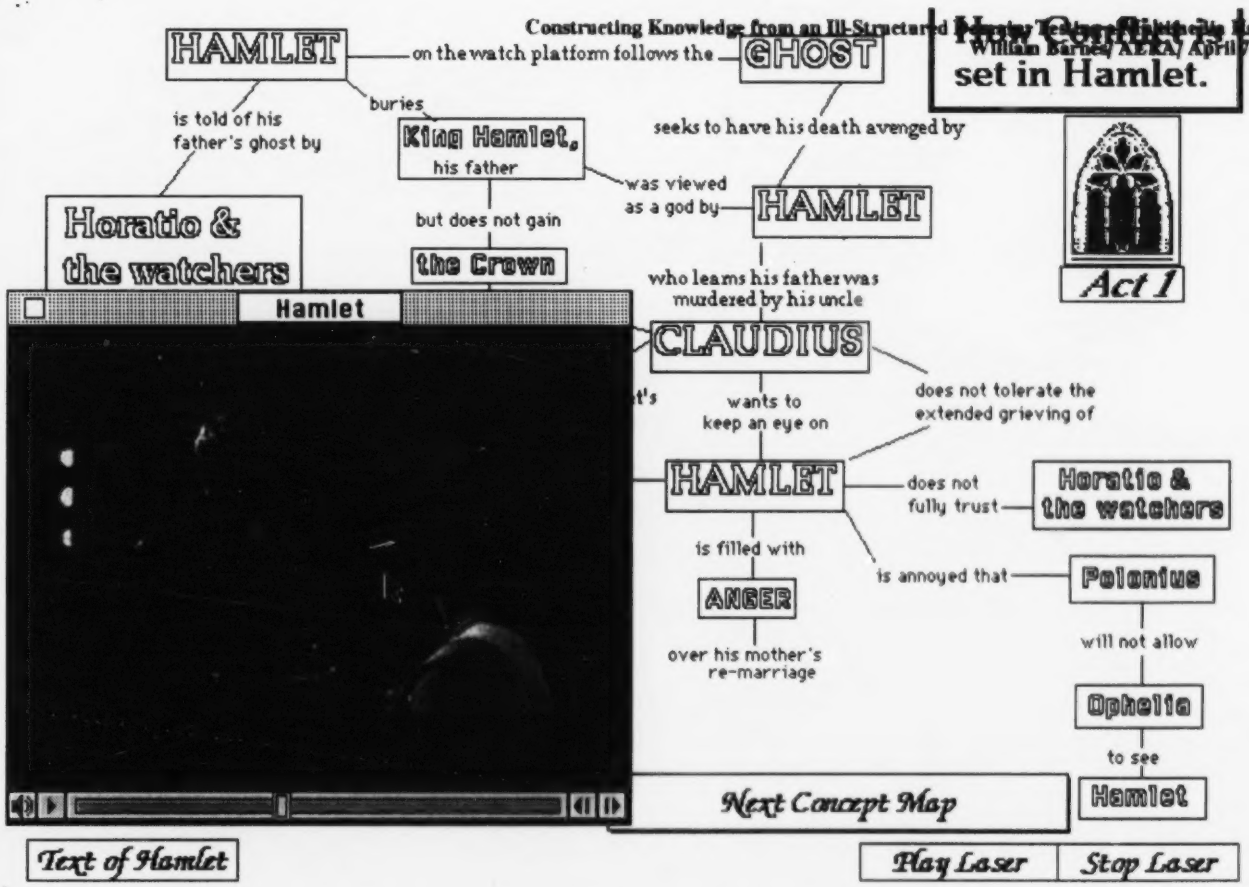


See Lines of this scene...

See Criticism

Text of Hamlet

BEST COPY AVAILABLE



Hamlet Learns How His Father Was Killed From His Father's Ghost

Hamlet is driven by the suffering described by the ghost as well as by the command to seek revenge:

[The re-creation of his father's death is played within the play.]

GHOST But that I am forbid
To tell the secrets of my prison-house,
I could a tale unfold whose lightest word
Would harrow up thy soul, freeze thy young blood
Make thy two eyes, like stars, start from their sphe
Thy knotted and combined locks to part
And each particular hair to stand on end,
Like quills upon the fretful porpentine:
But this eternal blazon must not be
To ears of flesh and blood. List, list, O, list!
If thou didst ever thy dear father love–
HAMLET O God!
GHOST Revenge his foul and most unnatural m
HAMLET Murder!
GHOST Murder most foul, as in the best it is;
But this most foul, strange and unnatural.
HAMLET Haste me to know't, that I, with wings as swift
As meditation or the thoughts of love,

Start This Scene

Text of Hamlet

Play Laser | Stop Laser

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